

## HAEMATOCRIT (PACKED CELL VOLUME - PCV)

Blood is a viscous, opaque, red liquid, consisting of figurative elements: erythrocytes, leukocytes, platelets, suspended in a liquid which are called plasma. When blood is collected in an anticoagulant and centrifuged, erythrocytes are submitted in the lower part of the vessel, white blood cells form a thin film on the surface of red blood cells and yellow plasma occupy the top.

**DEFINITION:** Haematocrit or packed cell volume is the compact volume occupied by the red blood cells in a given volume of blood, expressed as a percentage.

**PRINCIPLE:** blood is collected in anticoagulant, is centrifuged 30 min at 3000 rotations / mins. The blood column height (H) and erythrocyte column height (h) are determined and we calculate using the formula:

$$\text{HCT} = \frac{h}{H} \times 100$$

Where H= the height of blood column (in mm); h = the height of RBC column (in mm).

### *Methods for determination are divided into:*

- Macrometric method (Wintrobe) or macrohaematocrit (low speed centrifugation takes place in tubes with a diameter of 3 mm)
- Guest or microhaematocrit or micrometric method (centrifugation takes place in capillaries).
- Automated method - the PCV is calculated by an automated analyzer and it is not directly measured.

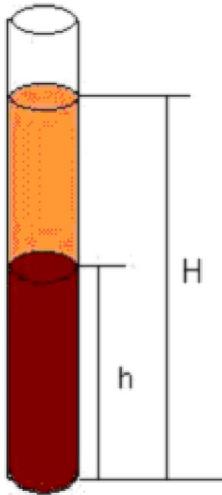


Figure no. 3 Determination of haematocrit by micrometric method

**MATERIALS:** heparin zed capillary tubes (glass capillary tubes with a bore of about 1 mm and a length of about 7 mm; the walls of this tubing are thin and it is easily sealed by the heat of a very small flame), centrifuge, needle, cotton, alcohol.

### **PROCEDURE for manual microhaematocrit method**

Blood is drawn by way of a puncture in the finger after disinfecting the finger's surface with alcohol. The skin of the finger should be perfectly dry at the time of puncture; no alcohol or other antiseptic should be permitted to dilute or hemolyze the blood. The first drop of blood is wiped away. One or two capillary tubes fill at least three quarters. Opposite end of which was filled close (to flame or cement, clay). Tubes place into the centrifuge and centrifuge at 4000 rpm / min for 5 min. The tube is placed into the centrifuge with the sealed

end against the ring of rubber at the circumference. The centrifuge should be loaded with an even number of tubes, to properly balance the load.

The proportion of RBC to the total blood volume can be visually measured. The height of the column of RBCs is measured by placing the tube in the mechanical tube reader or using a ruler. The height of the column of RBCs is related to the height of the column of blood introduced initially into the tube.

## **INTERPRETATION**

Normal values for venous haematocrit are between:

- ♣ 42-52% in men
- ♣ 36-48% in women
- ♣ 44-64% of newborn

## **VARIATIONS:**

### 1) physiological variations:

- a) The hematocrit has decreased values in capillaries (hematocrit = 20% in the skeletal muscle capillaries), but in the spleen capillaries the value is 70-80%, because of the sequester function of the spleen;
- b) The new-born children have a physiological polycythemia that is why their hematocrit is increased;
- c) In the period of pregnancy the hematocrit is decreased (there is a hemodilution because the plasma volume increases)
- d) The people who live at height (6000-7000 m) have increased values of the hematocrit. The explanation is the fact that at high altitude the air is rarefied and hypoxia occurs. Hypoxia stimulates the erythropoiesis (production of red blood cells in the bone marrow) and increases the number of erythrocytes. The result of increased erythrocyte number is the increase of the hematocrit.

### 2) pathological variations:

- a) Polycythemia means increased number of erythrocytes. There are two types of polycythemia:
  - polycythemia vera or primary polycythemia;
  - secondary polycythemia occurs whenever the tissues become hypoxic (for instance heart failure, pulmonary sclerosis, intoxications with carbon oxide) in both polycythemia (poliglobulia has the same meaning) the hematocrit is increased (up to 80 %!) The blood with increased hematocrit becomes more viscous and predisposes at thrombosis.
- b) Patients with anemia have decreased haematocrit because of the decreased red blood cell number.
- c) After bleeding at the beginning the hematocrit remains the same but after a period of time, the hematocrit decreases. This hemodilution is explained by the passage of water and micromolecules from the interstitium into the blood capillaries (this is an adaptative reaction of the body at the decreased blood volume after hemorrhage!)

d) The hematocrit increases in the period of shock. The water and micromolecules pass from the blood into the interstitial fluid because of the hyper permeability of the capillaries.

Elevated levels of HCT define polycythemia - may be associated with:

- Normovolaemia on the high altitude
- Hypovolaemia in haemoconcentration (dehydration, shock)
- Hypervolaemia in polycythemia

Low values of HCT- oligocytemia - may be associated with:

- Normovolaemie in anemia
- Hypovolaemia in severe anemia
- Hypervolaemia after infusions of plasma

Normal values of HCT - normocythemia - may be associated with:

- Normovolaemia = normal physiological conditions
- Hypovolaemia in acute bleeding (first phase)
- Hypervolaemia after transfusion of whole blood, heart failure and hyperthyroidism.

### **THE IMPORTANCE**

- contribute to the diagnosis of anemia together with the concentration of hemoglobin and red blood cell counts;
- it is necessary to calculate the RBC constants;
- leukocyte layer can attract attention to a leukemia;
- plasma appearance may show a possible hemolysis or jaundice.

